REMARKS / ARGUMENTS

For the convenience of the Examiner and clarity of purpose, Assignee has reprinted the substance of the Office Action in ***10-point bolded and italicized font.*** Assignee's arguments immediately follow in regular font.

> ***3. The outstanding claim objections are withdrawn in light of applicant's arguments filed on 12/21/2007.***

Applicant thanks the Examiner for her withdrawal of the previous objections in view of the amendment filed on December 21, 2007.

Claim Rejections - 35 USC § 103

> ***5. Claims 1, 4-11, and 37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sasaki et al (JP 05-238799, machine translation) in view of Wooster et al (US 3,341,555) and Inoue (US 5,422,391).***
> ***The rejection is adequately set forth in paragraph 5 of Office action mailed on 6/21/2007 and is incorporated here by reference.***

Applicant respectfully traverses the Examiner's rejection of claims 1, 4-11, and 37. According to MPEP § 706.02(j), for a claim to be obvious, there must be a) a suggestion or motivation to combine reference teachings, b) a reasonable expectation of success, and c) the references must teach all of the claim limitations, *In re Vaeck*, 947 F.2d 488, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991). Without acceding to the Examiner's characterization of what the cited documents of record teach or suggest, Applicant contends that the Examiner has not identified any teaching or suggestion with the Sasaki, Wooster, and/or Inoue documents for combining the references in the manner suggested—in fact, and as detailed further below, the combination suggested by the Examiner is effectively inoperable and would clearly not result in the

Applicants instantly claimed invention. Further, Applicant contends that none of the cited art, alone or in combination, describe, suggests or teaches the curable resinous compositions specifically described in the presently amended claims.

Without acceding to the Examiner's characterization of Japanese Patent Publication No. 05-238799 (hereinafter, 'Sasaki'), or the level of ordinary skill in the art, the Sasaki document of record describes only an epoxy resin composition for use in forming artificial marble which can be molded. As described therein, the epoxy resin composition includes an epoxy resin having 150-350 average epoxy equivalents, a carboxylic anhydride, a quaternary phosphonium salt, and an inorganic filler in an amount of from 100-500 wt. % of the total weight of the resin and anhydride (Abstract, paragraph [0004]. Notably, the products produced using the compositions and methods of Sasaki require extended setting times (e.g., 70 hours + ; paragraph [0014]), as well as requiring heating and pressure-treatment steps following first only half-solidifying the resin mixture, in order to generate a final artificial marble product (example 1, paragraph [0011]).

Applicant's instant composition, in contrast, is a pourable resinous composition that does not use heat or pressure, as described and seemingly required by Sasaki, nor does it require such extended setting times. Additionally, Applicant's instantly claimed composition as recited in independent claim 1 (upon which claims 4-11 depend), does not describe or contemplate the compositions and methods of forming products described in the Sasaki document.

With regard to Wooster et al. (U.S. Patent No. 3,341,555, hereinafter 'Wooster'), Applicant again does not accede to the Examiner's characterization of what the Wooster

document teaches, nor the Examiner's characterization of the level of ordinary skill in the art, and reserves the right to challenge both of these characterizations in the future. Wooster describes liquid dicarboxlic acid anhydride compositions which, among other things, ***essentially*** comprise cyclic anhydrides of polycarboxylic acids in the form of stable homogeneous liquids which are freeze-thaw resistant, and which when frozen will revert to their original homogenous liquid state upon warming to about 20-30 °C (column 2, lines 21-31; emphasis added), as well as processes for preparing such compositions. The compositions of Wooster are also described to contain a stabilizing agent which is specifically described to be "the reaction product of equimolar quantities of a tertiary amine and a polycarboxylic acid anhydride" as a tertiary amine-anhydride complex, which obviates the need for the use of accelerators, and which prevents having to preheat the anhydride to an elevated temperature in order to keep the curing mass in the liquid phase. In fact, Wooster specifically suggests **against** any improvements or modifications to higher-temperature epoxy resin mixtures, and focuses on those compositions which can simultaneously handle low temperatures and then be handled at ambient temperature.

Applicants pending independent claim 1 (and claims 4-11, and 37 dependent thereon) does not describe or contemplate the compositions and methods of blending described and claimed by Wooster. Rather, Applicants described and claimed curable resinous compositions are pourable, comprise carboxylic anhydrides that are not required to cyclic (as Wooster's composition specifically regards as "essential"), and do NOT contain the stabilizing agent required by Wooster so as to negate the need to heat the composition. In fact, looking to the Examples of the instant application (e.g., Example 1), the mixture is heated to a temperature of

about 240 °F, and then poured into a mold—this is in stark contrast to, and completely opposite of, the teachings presented by Wooster. Further, and contrary to the Examiner's assertions, there is no suggestion, inherently or otherwise, by Wooster to combine with or modify the teachings of Sasaki or Inoue, alone or in combination, so as to obtain the Applicants instant inventive composition as currently described and claimed. In fact, the Examiner's suggested combination would likely result in an inoperable composition, and at least would form a composition that is not equivalent to that presently described and claimed. Consequently, Wooster is clearly not applicable to the Applicant's instantly-claimed compositions and products, as amended herein.

Without acceding to the Examiner's characterization of U.S. Patent No. 5,422,391 to Inoue, the Inoue document of record describes only a high-density artificial stone composition that consists of thermosetting resins, 10 – 70 mesh [2 mm - 211 mm] inorganic "fine" particles from natural stone, ceramics, etc. which are mixed with 100 mesh (150 mm) or above "very fine" inorganic particles (such as $CaCO_3$ or Al_2O_3) in a weight ratio ranging from 0.5 : 1 to 5: 1 (abstract; column 3, lines 45-55; column 4, lines 1-7), such that the particles account for at least 85% of the weight of the final product (column 4, lines 33-38). As specifically stated by Inoue, "[i]f the ratio is less than 85%, the end product is too soft, and has a poor property as stone". (Column 4, lines 37-38). In stark contrast, Applicants instantly claimed curable resinous composition, such as recited in independent claim 1, comprises at least one inorganic filler (C) having a particle diameter size ranging from about 10 to about 40 microns (0.01 mm – 0.04 mm), and at least one inorganic filler (D) having a particle size greater than about 90 microns (0.09

mm), wherein the ratio of inorganic filler (C) to inorganic filler (D) is 7 : 1 to 1 : 1.5 (page 6, lines 17-18). Thus, Applicant's instantly claimed composition has non-equivalent particle sizes, with the smallest particles used by the Applicants being on the order of at least 5 times smaller in average diameter.

Further, the composition described and claimed by Inoue has a much greater percent filler total (by weight) than Applicant's composition, making it less pourable and consequently resulting in the Inoue composition having diminished physical characteristics. In fact, the Inoue composition is specifically suggested to be a "sprayable" composition, as seen in Example 3 (column 9, lines 1-7)—thus, Inoue effectively "teaches away" from the instantly described and claimed compositions.

The combination of different factors illustrated above with regard to Inoue—different particle sizes in specific ratios and high filler content—results in compositions with markedly different characteristics, making the Inoue composition unsuitable for use in curable resinous compositions such as the counter-tops and similar work surfaces described and claimed by the Applicant. This is perhaps most clearly illustrated in the summary table below, Comparison Table I, based on the Examples of Inoue and the instantly claimed compositions. As can be seen from the comparison table, the composition of the currently pending claims has a compressive strength **3.5 TIMES GREATER** than that of the Inoue product, and has a tensile strength **3 TIMES GREATER** (on average) than that of the Inoue product, indicating that the instantly described and claimed curable resinous composition is not only pourable and quickly curable, but also has significantly enhanced physical properties, making it much more desirable for use in

the formation of surface products and the like.

Comparison Table I.

Test Characteristic	Invention Composition (Ex. 1)	Inoue Example 1	Inoue Example 2	Inoue Example 4
Compressive strength[1]	30,509 psi (2,145 kg/cm^2)[4]	605 kg/cm^2	605 kg/cm^2	610 kg/cm^2
Tensile Strength[2]	5,395 psi (379.3 kg/cm^2)	122 kg/cm^2	130 kg/cm^2	120 kg/cm^2
Bending/Flexural Strength[3]	11,300 (794.5 kg/cm^2)	640 kg/cm^2	660 kg/cm^2	750 kg/cm^2

[1]Determined using ASTM method D695.
[2]Determined using ASTM method D638.
[3]Determined using ASTM method D790.
[4]Conversion made using the pressure conversion of 1 pound-per-in^2 (psi) = 0.07030695783 kg/cm^2.

Consequently, and contrary to the assertions of the Examiner, one of skill in the art, upon combining Inoue in the manner suggested, would not obtain a product equivalent to that described and claimed by the Applicant. In fact, in view of the results shown in Comparison Table I, one of skill in the art, upon reading the Inoue document, and in direct contrast to the assertions of the Examiner, would specifically NOT turn to the Inoue document of record in order to make a curable resinous composition suitable for use in forming counter-tops and similar surfaces. Reconsideration of this rejection in view of Inoue is respectfully requested.

Finally, Applicant further traverses this rejection due to the fact that the Examiner has asserted that certain facts are common knowledge and common sense, without citing a specific art reference. Specifically, the Examiner has stated that "it would have been obvious to one of

ordinary skill in the art to utilize...Sasaki to obtain a more stable, homogenous composition at ambient temperatures".

As stated in the MPEP § 2144.03, it is "not appropriate for the examiner to take official notice of facts without citing a prior art reference where the facts asserted to be well known are not capable of instant and unquestionable demonstration as being well-known. For example, assertions of technical facts in the areas of esoteric technology or specific knowledge of the prior art must always be supported by citation to some reference work recognized as standard in the pertinent art. *In re Ahlert*, 424 F.2d at 1091, 165 USPQ at 420-21." [Emphasis in original]. As stated therein, "it is never appropriate to rely solely on 'common knowledge' in the art without evidentiary support in the record, as the principal evidence upon which a rejection was based. *Zurko*, 258 F.3d at 1385, 59 USPQ2d at 1697 ('[T]he Board cannot simply reach conclusions based on its own understanding or experience-or on its assessment of what would be basic knowledge or common sense. Rather, the Board must point to some concrete evidence in the record in support of these findings.')." As the court held in *Zurko*, an assessment of basic knowledge and common sense that is not based on any evidence in the record lacks substantial evidence support. *Id.* at 1385, 59 USPQ2d at 1697. As was further held in Zurko, PTO findings of fact "must be reviewed under the Administrative Procedure Act (APA) standards of review", and that substantial evidence [such relevant evidence as a reasonable mind might accept as adequate to support a conclusion] is the correct APA standard of review for factual findings. *Id.* at 1381, *Dickinson v. Zurko*, 527 U.S. 150 (1999), *In re Gartside*, 203 F.3d 1305, 53 USPQ2d 1769 (Fed. Cir. 2000). Thus, the Examiner cannot simply reach conclusions based on her own

understanding or experience, or her assessment of what would be basic knowledge or common sense. Rather, the Examiner must point to some concrete evidence in the record to support these findings. In the instant case, the Examiner has failed to do so, in contrast to the standard of review of the APA which governs review of obviousness determinations such as these, and has misread and misinterpreted the cited documents of record.

In traversing the Examiner's statement, and in accordance with 37 CFR **1.111**(b) and *In re Chevenard*, 139 F.2d 711, 713, 60 USPQ 239, 241 (CCPA 1943) ("[I]n the absence of any demand by appellant for the examiner to produce authority for his statement, we will not consider this contention."), Applicant contends that the cited errors in the Examiner's action, in particular the far-reaching combinations of art which are strung together with no concrete evidence, but only the Examiner's personal experiences, ideas and the benefit of hindsight, should not be considered to be supported by common knowledge or well-known in the art, as alleged. Consequently, Applicant respectfully requests that the Examiner withdraw such objections, or alternatively, provide support for the lack of substantial evidentiary support in her statements. Applicant contends that the Examiner needs either withdraw her allegations, or alternatively, provide authority, because there are numerous types and classes of resin compositions and formulations, often created for very specific and focused applications with targeted physical characteristics overall, the multitude of which are generally not predictable or interchangeable between systems, or applications. For example, a resin composition having certain characteristics for application to spray forming a sink, toilet, or other manufactured product is not equivalent to, or interchangeable with, a curable resinous composition such as

described in the present application, having physical characteristics desirable for use in a countertop or similar work surface which must withstand a high degree of object impact and use, yet be economical and easy to form in a multitude of configurations depending upon the location. Similarly, the interchange of components of such resinous compositions—e.g., inorganic fillers of specific sizes and origin—contrary to the Examiner's suggestions, are not common-place, and are often very application, composition, and end-use specific, and would likely not have predictable results if interchanged as suggested by the Examiner. Reconsideration is therefore respectfully requested.

Accordingly, in view of the these distinctions, Applicant requests that the rejection of claims 1, 4-11, and 37 under 35 U.S.C. § 103 be withdrawn.

> ***6. Claims 2, 3, 12, 15-31, and 37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sasaki et al (JP 05-238799, machine translation) in view of Wooster et al (US 3,341,555) and Inoue (US 5,422,391) and further in view of Traverso et al (US 5,280,051).***
>
> ***The rejection is adequately set forth in paragraph 6 of Office action mailed on 6/21/2007 and is incorporated here by reference.***

Applicant respectfully traverses this rejection. Additionally, Applicant does not accede to the Office's characterization of any of the Sasaki, Wooster, Inoue and/or Traverso references as applied to claims 2, 3, 12, 15-31 and 37, and respectfully reserves its right to challenge those characterizations in the future. Further, Applicant does not accede to the Office's characterization of the level of one of ordinary skill in the art, and reserves its right to challenge such characterization in the future.

First, the Sasaki, Wooster, and Inoue documents have been described and distinguished over the instant application above with respect to claims 1, 4-11, and 37, and thus dependent claims 2, 3, 12, 15-17 and 37 are believed to be allowable by depending from an allowable claim. These distinctions are similarly believed to apply to independent claims 18, 27, 29 and 32 as well, and thus for at least these reasons claims 15-31 are believed to be distinguishable over at least Sasaki, Wooster and Inoue.

Further, and without acceding to the Examiner's characterization of U.S. Patent No. 5,280,051 to Traverso *et al* (hereinafter 'Traverso'), or the level of one of ordinary skill in the art, this patent describes only a composition for artificial marble or granite products for use in outdoor (exterior) settings and having a polyol and a mineral filler, wherein the mineral filler is described to be comprised of at least 50-80% by weight of particles having a particle size greater than 0.5 mm (greater than 500 microns) in size (abstract, column 2, lines 20-22). Applicants instantly claimed invention comprises inorganic fillers having a particle diameter size from about 10 to about 40 microns (about 0.01-0.04 mm), a particle size that is at least **five times less** than that described and required by Traverso. Thus, the combination of Traverso in the manner suggested by the Examiner would not generate a product having the same physical properties, and which would not be suitable for use as a countertop as the Applicant's claimed composition is.

Additionally, the combination of Sasaki, Wooster, Inoue and Traverso as suggested by the Examiner is inappropriate, and would not teach the Applicant's instant invention, as such a combination would generate only a non-pourable resinous product having different physical

properties, such as lower tensile strengths, compressive strengths, and bending strengths—a product that is not the same as, or equivalent to, the present invention.

Accordingly, in view of the these distinctions, Applicant requests that the rejection of claims 2, 3, 12, 15-31 and 37 under 35 U.S.C. § 103 be withdrawn.

> ***7. Claims 32 and 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sasaki et al (JP 05-238799, machine translation) in view of Wooster et al (US 3,34 1,555) and Inoue (US 5,422,391) and further in view of Platka et al (US 4,244,993).***
>
> ***The rejection is adequately set forth in paragraph 7 of Office action mailed 6/21/2007 and is incorporated herein by reference.***

Applicant respectfully traverses the Examiner's rejection of claims 32 and 36. First, claims 32 and 36 depend, ultimately, from independent claims 1 and 18, which have been distinguished supra, and are believed to be allowable. Consequently, claims 32 and 36 are believed to be allowable by depending from an allowable independent claim.

Additionally, with regard to the Examiner's suggestions regarding the combination of Sasaki in view of Wooster, Inoue, and further in view of the Platka document as detailed in the Action, the Sasaki, Wooster, and Inoue documents have been described and distinguished from the Applicant's instant invention above. Applicant however does accede to the Examiner's statement that at least the Sasaki document does not disclose the use of artificial marble compositions in the preparation of countertops and the like.

The Examiner has alleged, in this rejection of claims 32 and 36, that "Platka teaches that synthetic marble products are well recognized in the art and include countertops (col. 1, lines 25)" and that "it would have been obvious to one of ordinary skill in the art to utilize the marble composition of Sasaki et al in a countertop as taught by Platka...". Without acceding to the

Examiner's characterizations of the Platka document (U.S. Patent No. 4,244,993), or the Examiner's characterization of the skill level of "one of ordinary skill in the art", the Platka document describes and claims only methods for the manufacture of *simulated* marble and onyx products, which method includes the process of applying and re-applying a resin/filler composition *over* a pre-formed mold, such as that for a sink. The method specifically described involves spraying (one or more times) a resin/filler composition over a mold, and after the requisite number of layers of the resin/filler composition have been applied, curing the product in an oven for a period of time, typically greater than an hour (column 7, lines 5-9). This overall process described by Platka thus takes an extended period of time, e.g., greater than 1 day, in order to form a product, whereas Applicant's instantly described and claimed process takes less than 1 day to perform in order to create a counter-top product. Additionally, Applicant's products are formed by pouring, and due to the overall characteristics of the slurry formed, e.g., their viscosity, they cannot physically be sprayed over a pre-formed mold to make a synthetic marble product such as described in the Platka document.

Applicant's invention has been described in detail above. As mentioned previously, Applicant's compositions are too thick to be sprayed onto molds in manners such as described by Platka. Rather, due to the compositions described and claimed by Applicants, the instantly described and claimed compositions have a viscosity that it is much greater than that of Platka (reportedly in the range of 100-1600 cPs)—in fact, the viscosity of the Epon™ 828 resin used in the Examples reported in the pending application is reportedly 110-150 P (11,000 – 15,000 cPs). [See, attached Technical Data Bulletin for EPON™ Resin 828, for resin properties.] This is at

least 10 orders of magnitude greater than that of the polymer resins described and used by Platka. Thus, owing in part to the much greater viscosity of the curable compositions, Applicant's instant compositions must be poured into molds, and are ***highly incapable*** of being sprayed. Thus, the combination suggested by the Examiner is non-workable and would be inoperable.

Further, Applicant's instant invention has been distinguished over the Sasaki document, and thus in the event that one were to make the combination suggested by the Examiner, such a composition and product formed not only could not likely be made without undue experimentation in order to overcome the physical differences that would result from such a proposed combination, but also would not be the same as, or equivalent to, that which would result from the compositions and methods described herein.

Consequently, claims 32 and 36 are likewise believed to be patentable over Sasaki, Wooster, Inoue, or Platka, alone or in combination, as none of the cited art references teach or suggest a combination which would result in Applicants currently pending claims being obvious. Reconsideration is respectfully requested.

> ***8. Claims 34 and 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sasaki et al (JP 05-238799, machine translation) in view of Wooster et al (US 3,341,555) and Inoue (US 5,422,391) and further in view of Traverso et al (US 5,280,05 1) and Platka et al (US 4,244,993).***
>
> ***The rejection is adequately set forth in paragraph 8 of Office action mailed on 6/21/2007 and is incorporated herein by reference.***

Applicant respectfully traverses this rejection of claims 34 and 36. As detailed above, and as stated by the Examiner, Applicant contends that the Sasaki document does not disclose or teach the features recited in pending claims 34 or 36, in particular the use of artificial marble compositions in a countertop. As discussed previously herein, and according to MPEP §

706.02(j), for a claim to be obvious, there must be a) a suggestion or motivation to combine reference teachings, b) a reasonable expectation of success, and c) the references must teach all of the claim limitations, *In re Vaeck*, 947 F.2d 488, 20 U.S.P.Q. 1438 (Fed. Cir. 1991). The Examiner has not identified the requisite motivation for with respect to Sasaki, Wooster, Inoue, Traverso, or Platka for combining these documents of record in the manner suggested by the Examiner, which would result in the Applicants instant invention.

First, for at least the reasons discussed above with respect to independent claims 1 and 18, upon which claims 34 and 36 reference, these claims have been distinguished over the cited references. Consequently, claims 34 and 36 are likewise believed to be patentable over Sasaki, Wooster, Inoue, Traverso, or Platka, alone or in combination, as none of the cited art references teach or suggest a combination which would result in Applicants currently pending claims being obvious. Therefore, Applicant does not accede to the Office's characterization of any of Sasaki, Wooster, Inoue, Traverso, or Platka as applied to claims 34 and 36, or the Examiner's characterization of one of skill in the art, and respectfully reserves its right to challenge that characterization in the future. Additionally, it is believed that claim 36 is allowable by depending on an allowable independent claim.

Accordingly, in view of the above distinguishing arguments, and in view of claims 34 and 36 reference to independent claims 1 and 18 which have been distinguished over the cited references previously herein, Applicant requests that the rejection of claims 9-11 under 35 U.S.C. § 103 be withdrawn.

* * * * *

CONCLUSION

Of the pending claims in this application, claims 1, 18, 27, and 29 have been amended herein, no claims have been cancelled, and no new claims have been added. With this response, claims 1-12 and 15-32, 34, and 36-37 remain pending in this application. Applicant respectfully submits that each claim is patentable, as detailed herein. A notice of allowance is respectfully requested.

Claims 1, 18, 27 and 29 have been amended herein to recite that the instantly claimed curable resinous compositions have the characteristic of being pourable. Support for these amendments may be found in the originally-filed specification, in the Examples section. Applicant respectfully submits that these amendments to the claims have not been made to the pending claims for the purpose of overcoming any rejections made by the Examiner or in response to characterizations made by the Examiner in this Action that would restrict the literal scope of the claims or equivalents thereof. Rather, these amendments have been made in order to make explicit that which was implicit in the application as originally filed.

Applicant does not believe that any fees are due at this time in association with this matter. However, should any additional fees under 37 C.F.R. §§ 1.16 to 1.21 be required for any reason relating to this document, the Commissioner is hereby authorized to deduct the requisite fees necessary to make this and related papers timely and effective from Locke Lord Bissell & Liddell LLP Deposit Account No. 12-1322, referencing matter number 0019377-00100.

Applicant thanks the Examiner for her consideration and effort on this matter and submits that this application is now in condition for allowance. Applicant respectfully requests that a

timely Notice of Allowance be issued in this case.

In order to expedite matters on this case, the Examiner is encouraged to contact the undersigned directly in order to advance this application toward allowance.

Respectfully submitted,

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05/12/2008
DATE

[redacted]

Technical Data Bulletin

HEXION™
Specialty Chemicals

EPON™ Resin 828

RP: 3075 **Re-issued: September 2005**

Introduction EPON™ Resin 828 is an undiluted clear difunctional bisphenol A/epichlorohydrin derived liquid epoxy resin. When cross-linked or hardened with appropriate curing agents, very good mechanical, adhesive, dielectric and chemical resistance properties are obtained. Because of this versatility, EPON Resin 828 has become a standard epoxy resin used in formulation, fabrication and fusion technology.

Features

- Fiber reinforced pipes, tanks and composites
- Tooling, casting and molding compounds
- Construction, electrical and aerospace adhesives
- High solids/low VOC maintenance and marine coatings
- Electrical encapsulations and laminates
- Chemical resistant tank linings, flooring and grouts
- Base resin for epoxy fusion technology

Typical Properties

Property	Test Method	Unit	Value
Epoxide Equivalent Weight [1]	ASTM D1652	g/eq	185-192
Viscosity @ 25°C [2]	ASTM D445	P	110-150
Color	ASTM D1544	Gardner	1 max.
Pounds per Gallon @ 25°C (77°F)		lbs/gal	9.7
Density @ 25°C (77°F)		g/ml	1.16
Physical form			Clear liquid
Vapor pressure @ 77°C (170°F)		mm Hg	0.03
Refractive index @ 25°C (77°F)			1.573
Specific heat		BTU/lb/°F	0.5

[1] ASTM D1652 (Epoxy Content of Epoxy Resins – Perchloric Acid Method)

[2] ASTM D445 (Kinematic Viscosity - Determinatin of the Viscosity of Liauids by Ubbelohde Viscometer).

General Information

The low viscosity and cure properties of EPON Resin 828 allow its use under various application and fabrication techniques including:

- Spraying and brushing
- Filament winding
- Pressure laminating
- Vacuum bag laminating
- Pultrusion
- Casting
- Molding
- Toweling

Curing Agents

EPON Resin 828 can be cured or cross-linked with a variety of curing agents depending on properties desired in the finished product and the processing conditions employed. Some commonly used curing agents, recommended concentrations, typical cure schedules employed in major end-use applications, plus sources for these curing agents are displayed in Table 1.

Perfomance Characteristics of Cured EPON Resin 828

Mechanical Properties

High performance, high strength materials are obtained when this resin is cured with a variety of curing agents. Unfilled systems in common use have tensile values greater than 10,000 psi (69 MPa) with modulus values greater than 400,000 psi (2750 MPa). Such systems are normally very rigid. If greater flexibility is needed systems can be formulated to provide up to 300% elongation.

Adhesive Properties

One of the most widely recognized properties of cured EPON Resin 828 is strong adhesion to a broad range of substrates. Such systems exhibit shear strength of up to 6,000 psi (41 Mpa). One factor which contributes to this property is the low shrinkage shown by these systems during cure. Compared to other polymers, epoxy resins have low internal stresses resulting in strong and durable finished products.

Electrical Properties

EPON Resin 828 cured systems have very good electrical insulating characteristics and dielectric properties. For example, systems can be obtained with anhydride and amine curing agents having volume resistivities up to 1 x 1016 ohm-cm, dielectric constants of 3-5 and dissipation factors of 0.002 to 0.020 at ambient conditions. Electrical encapsulations, laminates and molding compounds are frequently based on EPON Resin 828.

Chemical Resistance

Cured EPON Resin 828 is highly resistant to a broad range of chemicals, including caustic, acids, fuels and solvents. Chemically resistant reinforced structures and linings or coatings over metal can be formulated with EPON Resin 828.

Formulating Techniques

The primary components of a thermosetting resin formula are the epoxy resin and the hardener or curing agent. However, in practice other materials are normally incorporated to achieve special properties. For example, inert fillers such as silicas, talcs, calcium silicates, micas, clays and calcium carbonate can be added to further reduce shrinkage and improve dimensional stability. Also, reactive diluents can be added to EPON Resin 828 to reduce viscosity. The effect on viscosity by adding such materials is shown in Figure 1.

Table 1 / **Curing Agents for EPON™ 828**

Curing Agent [1]	Physical State	Recommended Concentration range, phr [2]	Typical Cure Schedule Time °C (°F)	Deflection Temperature [3] °C (°F)	Applications [4]	Suppliers [5]
Aliphatic Amines						
EPIKURE™ 3223 (DETA)	Liquid	12	7d, 25(77)	120(250)	ABCDEFHI	5
EPIKURE 3234 (TETA)	Liquid	13	7d, 25(77)	120(250)	ABCDEFHI	5
EPIKURE 3200 (AEP)	Liquid	22	24h, 25(77) & 1h, 150(300)	120(250)	BCEFGH	5
EPIKURE 3270	Liquid	75	14d, 25(77)	56(133)	ABCDEFHI	5
EPIKURE 3271	Liquid	18	14d, 25(77)	66(151)	ABCDEFHI	5
EPIKURE 3274	Liquid	40	14d, 25(77)	---	ABCDEFHI	5
EPIKURE 3230	Liquid	35	7d, 25(77)	68(155)	ABCDEFHI	1
D-400 Type PEA	Liquid	55	30 min, 115(240)	31(88)	ABCEFH	1
Cycloaliphatic Amines						
EPIKURE 3370	Liquid	38	7d, 25(77)	56(133)	ABCDEFHI	5
EPIKURE 3382	Liquid	63	7d, 25(77)	63(145)	ABCDEFHI	5
EPIKURE 3383	Liquid	60	24h, 25(77) & 2h, 100(212)	54(129)	ABCDEFHI	5
Polyamides						
EPIKURE 3115	Liquid	120	1h, 100(212)	85(185)	AB	5
EPIKURE 3125	Liquid	90	7d, 25(77)	90(195)	ABCEFH	5
EPIKURE 3140	Liquid	75	7d, 25(77)	115(240)	ABCEFH	5
Amindoamines						
EPIKURE 3015	Liquid	50	16h, 25(77) & 2h, 93(200)	---	ABCDEFHI	5
EPIKURE 3055	Liquid	50	16h, 25(77) & 2h, 93(200)	67(153)	ABCDEFHI	5
EPIKURE 3072	Liquid	35	14d, 25(77)	59(138)	ABCDEFHI	5
Aromatic Amines						
EPIKURE W	Liquid					5
Metaphenylenediamine (MPDA)	Solid	14	2h, 80(175) & 2h, 150(300)	150(300)	BCDGHI	3
Methylene dianiline (MDA)	Solid	27	2h, 80(175) & 2h, 150(300)	160(320)	BCDEGHI	13
Diaminodiphenyl Sulfone (DADS)	Solid	25	5h, 125(257) & 1h, 200(392)	170(350)	BCDGHI	2, 13

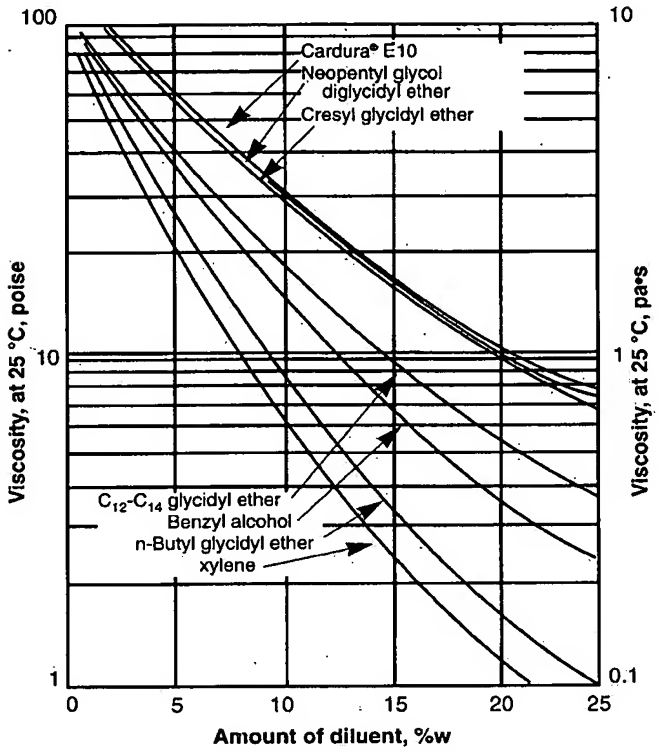
Table 1 / **Curing Agents for EPON™ 828 (cont.)**

Curing Agent [1]	Physical State	Recommended Concentration range, phr [2]	Typical Cure Schedule Time °C (°F)	Deflection Temperature [3] °C (°F)	Applications [4]	Suppliers [5]
Anhydrides						
Methyl tetrahydrophthalic Anhydride (MTHPA)	Liquid	80	2h, 120(250) & 2h, 150(300)	130(266)	BCDGHI	9, 11, 14
NADIC Methyl Anhydride (NMA)	Liquid	90	1h, 120(250) & 2-24h, 260(500)	180(356)	BCDGHI	9, 14
Hexahydrophthalic Anhydride (HHPA)	Solid	80	1h, 80(175) & 2h, 150(300)	130(265)	BCDGHI	8, 12, 14
Catalysts and Miscellaneous						
2-Ethyl- 4-Methyl Imidazole (EMI-24)	Metastable Liquid	3	4h, 50(122) & 2h, 170(340)	170(340)	BCDGHI	15, 16
BF3-Monoethylamine (BF3-MEA)	Liquid	3	1h, 120(250) & 2h, 170(340)	170(340)	BCDGHI	17
Diethylaminopropylamine [6]	Solid	6	30 min, 115(240)	100(212)	ABC	6
Dicyandiamide	Solid	4	1h, 177(350)	150(300)	BCDGHI	18, 19

[1] Cures can be effected with these curing agents over a wide range of temperatures. Higher temperatures yield shorter cure times and highest Tg.
[2] Parts of curing agent per 100 parts of resin.
[3] Systems cured at room temperature were post cured at elevated temperature to achieve deflection values.
[4] Application codes: A - Coatings; B - Adhesives; C - Castings; D - Moldings; E - Flooring; F - Paving; G - Electrical Laminates; H - Structural Laminates; I-Filament Winding.
[5] Supplier Code:
1. Huntsman Chemical
2. RSA Corporation
3. E.I. DuPont de Nemours & Co., Chemicals & Pigments Dept.
4. Harshaw Chemical Company
5. Hexion Specialty Chemical
6. BASF Corporation
7. American Cyanamid - Industrial Chemical Div.
8. Milliken & Company
9. Lindau Chemicals, Inc.
10. Anhydrides and Chemicals, Inc.
11. Dixie Chemical Co., Inc.
12. Buffalo Color Corp.
13. Air Products and Chemicals, Inc.
14. Lonza
15. Interchem
16. Polyorganix
17. Atotech
18. SKW Trotsbery
19. Ashland Chemical

[6] Dimethylamino propylamine may be substituted at expense of slightly reduced pot life. Sources are 2 and 16.

Figure 1 / **Viscosity at 25 °C of EPON™ Resin 828 blends with various diluents**



Fusion Technology

EPON Resin 828 is the product of choice for a resin chemist using a specific fusion catalyst when processing proprietary solid epoxy resins or epoxy esters. Upon request, Hexion Specialty Chemicals can provide EPON Resin 828 exhibiting extremely low hydrolyzable and total chlorine, two end groups that may be deleterious to resin curing and long term performance in electrical uses.

FDA Status

Provisions are made in the FDA regulations for the use of EPON Resin 828, when properly formulated, applied and cured, for food contact applications under Title 21 Code of Federal Regulations 175.300. The regulations should be consulted for complete details. In particular, we direct your attention to subparagraph (b) of 21 CFR 174.5 and the general provisions applicable to indirect food additives listed there.

Identification and Classification

Chemical Abstract Service Registry Number: 25068-38-6 (EPA/TSCA inventory designation)

Generic name: Liquid Bisphenol A Epichlorohydrin based epoxy resin.

Chemical designation: Phenol, 4,4O - (1-methylethylidene) bis-polymer with (chloromethyl) oxirane.

Figure 2 / **Viscosity - temperature profile for EPON™ Resin 828**

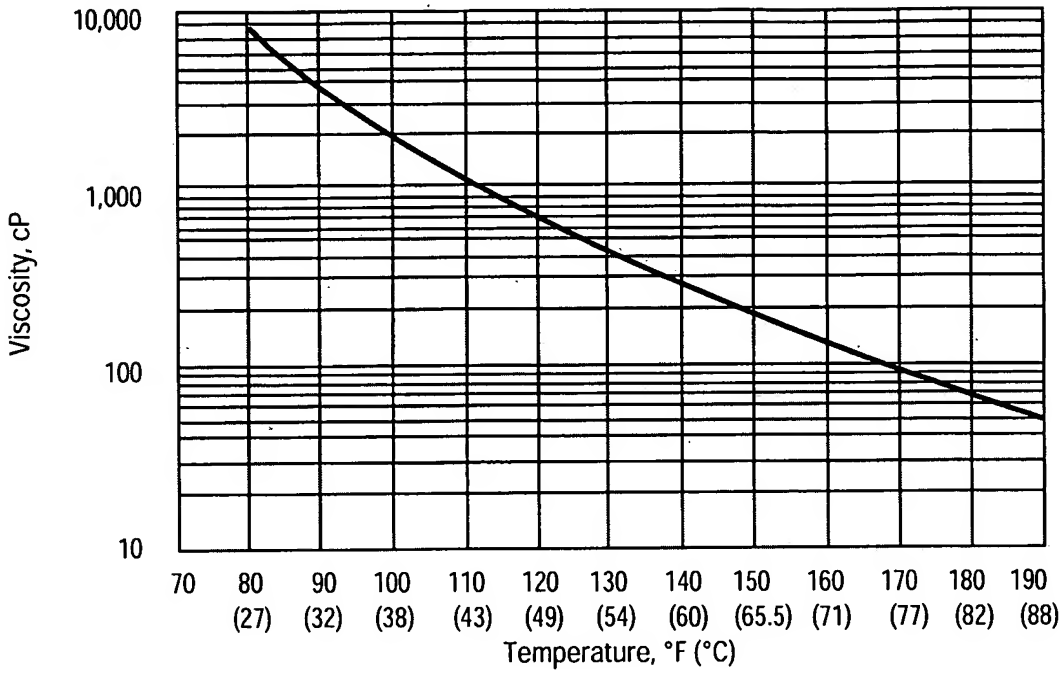
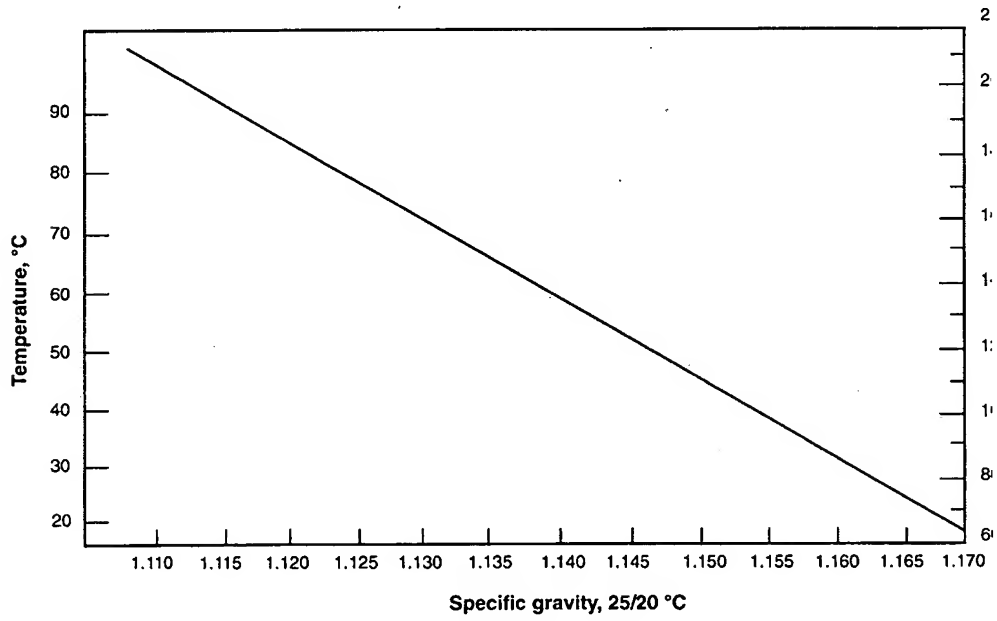


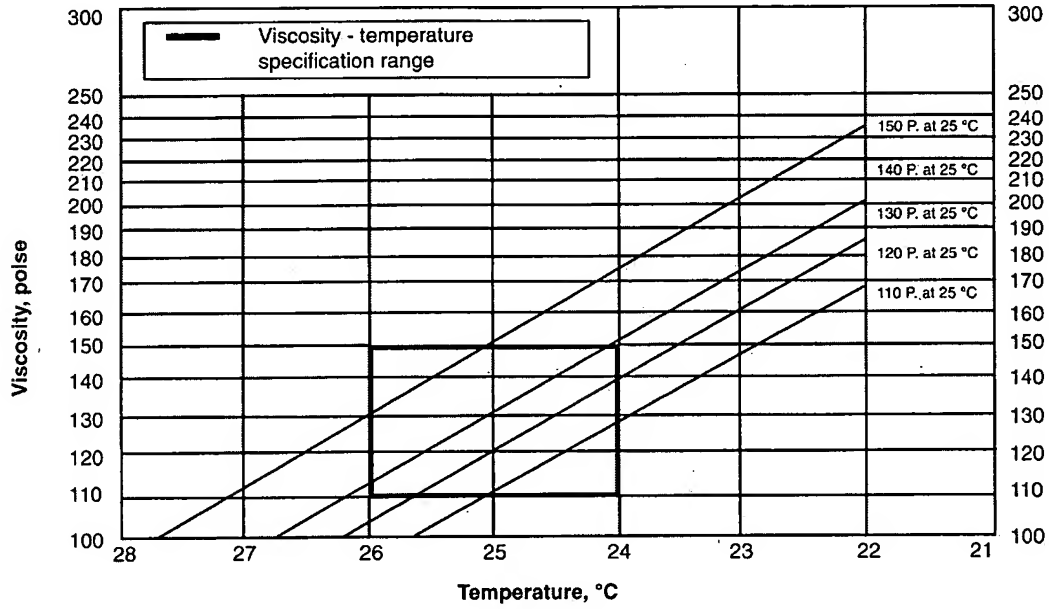
Figure 3 / **Specific gravity - temperature profile for EPON™ Resin 828**



Formulation and Application Information

For additional performance characteristics information covering adhesives, laminating, casting and molding applications, consult bulletin SC:67, entitled "EPON Resin Structural Reference Manual." For epoxy resin amine-cured coatings, consult bulletin SC:193, entitled "Formulating Amine-Cured Coatings with EPON Resin."

Figure 4 / **Viscosity - temperature profile (for 5 samples of EPON™ Resin 828 ranging in viscosity from 110-150 poise)**



Packaging and Storage

EPON Resin 828 is an undiluted liquid epoxy resin that is available in tank cars, tank trucks and 500 pound net closed head drums. EPON Resin 828 is normally shipped in bulk from 150 °F (66 °C) to 180 °F (82 °C) and can be stored at 120-140 °F (49-60 °C) for ease of handling. The viscosity/temperature profile and the specific gravity/temperature profile for EPON Resin 828 are displayed in Figures 2 and 3 respectively for your guidance.

EPON Resin 828 is susceptible to crystallization upon prolonged storage at normal ambient temperatures. It may be reconstituted by warming to 120-140 °F for 4-24 hours depending on the mass involved.

NOTE OF CAUTION: When checking viscosity of EPON Resin 828 incoming samples, we caution you to make certain that the product is maintained at 25 +/- 0.01 °C before testing. You will note in Figure 4 that EPON Resin 828 can vary in viscosity by 10-15 poise for each degree in temperature the product varies from 25 °C.

According to the Department of Transportation regulations (Code of Federal Regulations, Title 49), EPON Resin 828 is not classified or regulated as a flammable or combustible material. No special labeling is required for transportation.

For more storage information, please visit the "Shelf Life" section of our website at: www.hexion.com

For product prices, availability, or order placement, call our toll-free customer service number at:
1-877-859-2800

For sales in North and South America outside the United States, call:
1-832-366-2365

For literature and technical assistance, visit our website at:
www.hexion.com

SAFETY & HANDLING

These products are capable of producing adverse health effects ranging from minor skin irritation to serious systemic effects. Exposure to these materials should be minimized and avoided, if feasible, through the observance of proper precautions, use of appropriate engineering controls, and proper personal protective clothing and equipment, and adherence to proper handling procedures. **None of these materials should be used, stored, or transported until the handling precautions and recommendations as stated in the Material Safety Data Sheet (MSDS) for these and all other products being used are understood by all persons who will work with them.** Questions and requests for information on Hexion Specialty Chemicals, Inc. ("Hexion") products should be directed to your Hexion sales representative, or the nearest Hexion sales office. Information and MSDSs on non-Hexion products should be obtained from the respective manufacturer.

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